An overview of road accident fatalities in the European Union

Alexandra Laiou[1], George Yannis[2], Katerina Folla[3], Robert Bauer[4], Klaus Machata[5], Christian Brandstaetter[6]

[1, 2, 3]National Technical University of Athens (NTUA), [4, 5, 6]Austrian Road Safety Board (KFV)
[1]alaiou@central.ntua.gr, [2]geyannis@central.ntua.gr, [3]katfolla@central.ntua.gr, [4]robert.bauer@kfv.at, [5]Klaus.Machata@kfv.at, [6]Christian.Brandstaetter@kfv.at

Abstract

The objective of this research is the analysis of basic road safety parameters in the 28 EU countries, by the use of the EU CARE database with disaggregate data on road accidents, as well as of other international data sources (IRF, Eurostat, etc.). Time-series data on road accidents from these European countries over a period of 10 years (2005-2014) were correlated with basic safety parameters, such as type of the road, transport mode, season of the year, as well as with person related characteristics, like age, gender and road user type. The results of the analysis allow for an overall assessment of the road safety level in Europe in comparison to other modes of transport, thus providing useful support to decision makers working for the improvement of safety in the European road network.
Keywords: *fatalities, EU CARE database, road safety*

Περίληψη

Σκοπός της παρούσας έρευνας είναι η ανάλυση των βασικών παραμέτρων οδικής ασφάλειας στις 28 χώρες της Ευρωπαϊκής Ένωσης, αξιοποιώντας την Ευρωπαϊκή βάση δεδομένων CARE με αναλυτικά δεδομένα για οδικά ατυχήματα, καθώς και άλλες διεθνείς πηγές δεδομένων (IRF, Eurostat κ.ά.). Δεδομένα χρονοσειρών οδικών ατυχημάτων των παραπάνω Ευρωπαϊκών χωρών για μία περίοδο 10 χρόνων (2005-2014) συσχετίστηκαν με βασικές παραμέτρους οδικής ασφάλειας, όπως τύπος οδού, τύπος μέσου μεταφοράς, εποχή του χρόνου, καθώς και με χαρακτηριστικά σχετικά με τον παθόντα, όπως ηλικία, φύλο και τύπος χρήστη οδού. Τα αποτελέσματα της ανάλυσης θα επιτρέψουν την συνολική αξιολόγηση του επιπέδου οδικής ασφάλειας στην Ευρώπη, παρέχοντας κατ' επέκταση χρήσιμη υποστήριξη στους εμπλεκόμενους στη λήψη αποφάσεων που εργάζονται για τη βελτίωση της ασφάλειας του ευρωπαϊκού οδικού δικτύου.
Λέξεις κλειδιά: *νεκροί σε οδικά ατυχήματα, ευρωπαϊκή βάση δεδομένων CARE, οδική ασφάλεια*

1. Introduction

Road accidents are one of the leading causes of death worldwide, especially among young people aged between 15 and 29 years old. Road traffic injuries claim more than 1,2 million lives each year having a huge impact on public health and development. In fact, it is estimated that low and middle-income countries lose approximately 3% of GDP due to road traffic accidents (WHO, 2015). The European Commission has committed to improve the safety of the European road network. On that purpose, the EC has adopted a Road Safety Programme which aims to halve the number of road deaths by 2020, compared to the 2010 level. This target followed an earlier target set in 2001 to cut road fatalities by 50% compared to 2001, which was almost achieved (ETSC, 2016).

In the EU, about 350.000 people were killed in road accidents over the decade 2005-2014. An average annual decrease of 6% was recorded during this decade, with the highest reductions occurring between 2008 and 2010, which is possibly attributed to the financial crisis of 2008 and the subsequent economic downturn (OECD/ITF, 2015; Yannis et al., 2014). However, this fall in the annual number of road fatalities has stopped and in 2015 a 1% increase in road deaths was recorded, which means that the number of road deaths has to be reduced at a much faster average pace each year up to 2020, so as the EU achieves its target (ETSC, 2016). Consequently, it is essential that road accidents are investigated and continuously monitored, allowing for a better understanding of road fatalities characteristics and the implementation of the appropriate accident mitigation measures.

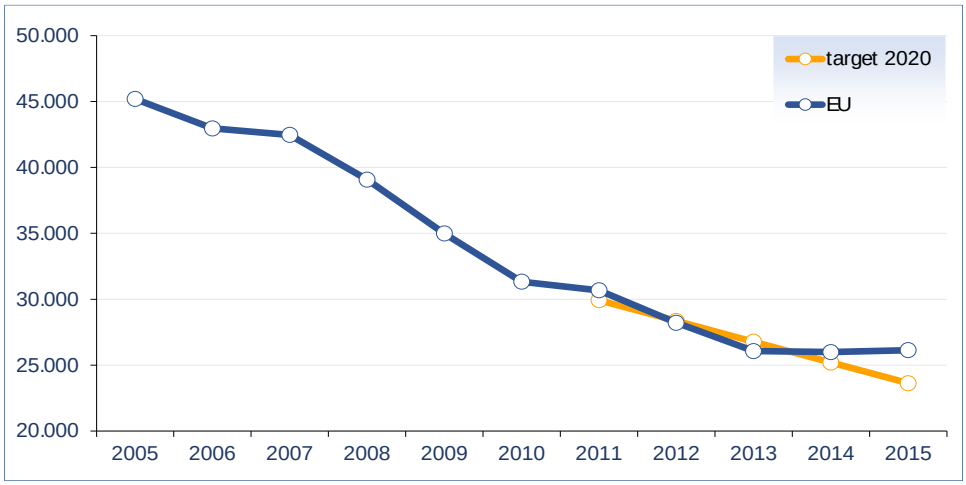
The objective of this research is the analysis of basic road safety parameters in European countries, through the use of the EU CARE database with disaggregate data on road accidents. More specifically, time-series road accident data from CARE for 28 EU countries over a period of 10 years (2005 - 2014) are correlated with basic safety parameters, such as type of road, transport mode, season of the year, as well as with person related characteristics, like age, gender and road user type. The paper is based on work done within the development of the Traffic Safety Basic Facts 2016 – Main Figures (European Commission, 2016), as well as through SAFETYNET and DaCoTA EC co-funded research projects and the European Road Safety Observatory (ERSO - http://ec.europa.eu/transport/wcm/road_safety/erso/index-2.html).

The results of the analysis allow for a better understanding of the road safety situation in Europe, thus providing useful support to decision makers working for the improvement of road safety level in Europe.

2. Overall road safety trends in the European Union

In 2014, about 25.900 people were killed in road accidents in the EU. In order to assess the road safety level in the EU, analyses of related accident data maintained into the EU CARE database can be performed. CARE is the Community database on road accidents resulting in death or injury, consisting of data with high level of disaggregation, contrary to most other existing international databases. This structure allows maximum flexibility and potential, with regard to analysis of the information available.

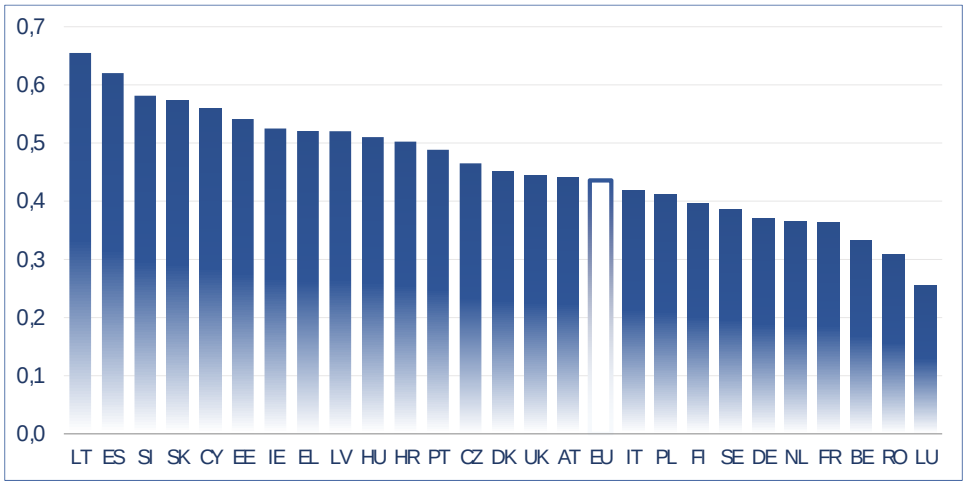
In order to monitor the evolution of the road safety, accident trends for the decade 2005 - 2014 were considered. Figure 1 presents the evolution of road accident fatalities in the EU for the examined period, as well as for 2015, in comparison with the road fatality target for 2020. According to the figure, there was a decrease of 42% in road accident fatalities in 2014 compared to the 45.192 fatalities in 2005. Specifically, the highest annual decreases in road accident fatalities (10,5%) were recorded in 2009 and 2010. It is also worth noting that in 2014 the intense decreasing trend of the previous years is stopped and in 2015 an annual increase of 1% is recorded.



Source: CARE database, data available in April 2017

Figure 1: *Number of road accident fatalities, EU, 2005-2015*

Figure 2 provides an overview of the change in number of fatalities in road accidents per country between 2005 and 2014. For the countries that 2014 data are not available, it is noted that the latest available data are used, meaning 2009 data for Bulgaria, 2010 data for Malta and 2013 data for Ireland, Slovenia and Slovakia. All examined countries experienced reductions in road fatalities over the decade, with the highest reduction being recorded in Lithuania and Spain (65% and 62% respectively) and the lowest in Luxembourg (26%). In general, 16 out of the 28 EU countries recorded higher decrease than the EU on average.



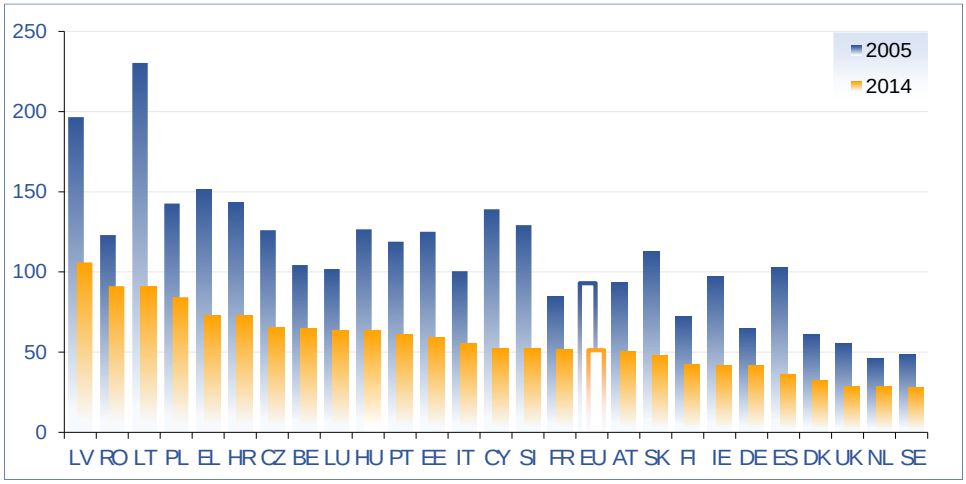
Source: CARE database, data available in May 2016

Figure 2: *Reduction of road fatalities by country, 2005-2014 or latest available year*

In road safety analysis exposure data is often used to calculate risk estimates, being defined as the rate of the number of accidents (or casualties) divided by the amount of exposure of a population over a time period (Hakkert and Braimaster, 2002, Hauer, 1995). On that purpose data from other international databases such as Eurostat, IRF etc. were also used. Since there

are no reliable data available about vehicle kilometres or person kilometres travelled in each of the above countries, the population is used as exposure data. The calculated risk figures may be used for different purposes, but their main objective is to enable the comparison of safety performance among different units, populations or countries.

Figure 3 shows the road fatality rates per million population in each of the EU countries in 2005 and 2014, as well as the EU average. The highest number of fatalities in road accidents per million population were recorded in Latvia, Romania and Lithuania in 2014, while the lowest fatality rates were recorded in Sweden, the Netherlands and the UK. In addition, the highest rate reduction over the decade occurred in Spain (65%), followed by Lithuania (61%).



Sources: CARE database (Eurostat for population data), data available in May 2016

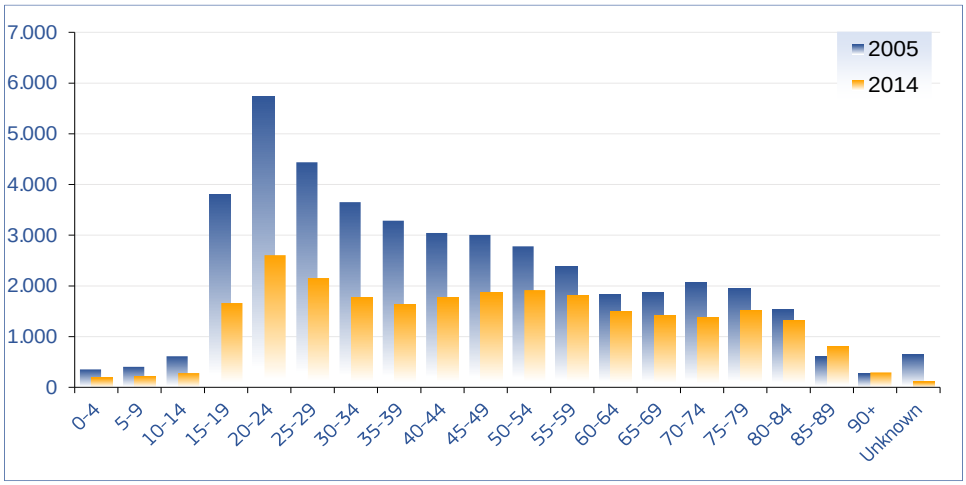
Figure 3: *Road fatality rates per million population by country, 2005 and 2014 or latest available year*

Moreover, it is obvious that at geographical level, the fatality rates per population tended to be lower in the north than in the south and lower in the west than in the east, which is probably the result of different historical backgrounds and policies for road traffic safety.

3. Road safety parameters of road accidents

3.1 Age and Gender

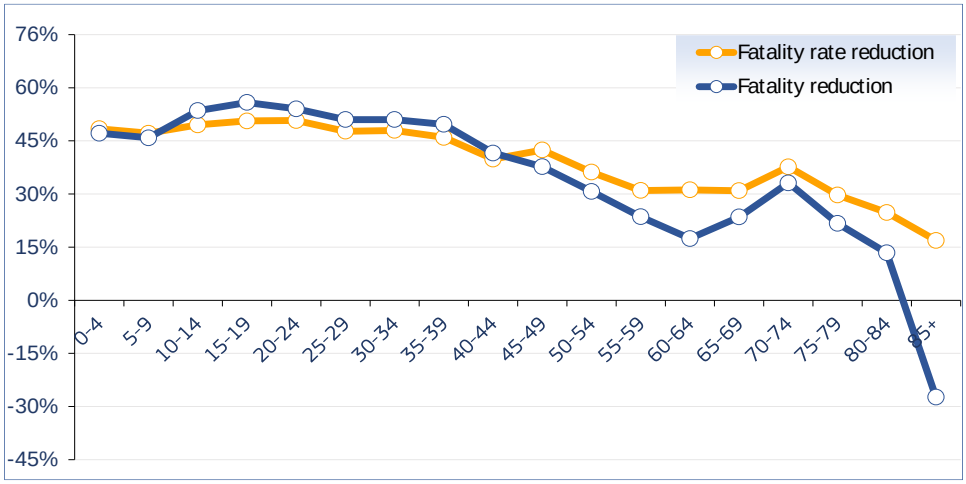
According to the results of a more detailed analysis by age groups and gender, the highest numbers of road fatalities are recorded between the ages 20 and 29 years old. In Figure 4 the road fatalities per 5-year age group for 2005 and 2014 are compared, showing that the distribution remained broadly the same. The number of fatalities decreased in all age groups, except the over 85 year old age groups.



Source: CARE database, data available in May 2016

Figure 4: *Number of road fatalities by age group, EU, 2005 and 2014 or latest available year*

Demographic change has contributed to the changes seen in Figure 4. The population of the EU countries grew by 2,5% over the decade 2005-2014, but the growth occurred mainly among the older age groups and indeed the population declined in the age groups between 10 and 44 years. Figure 5 presents the reduction in fatality numbers and fatality rates per million population by age group. Fatalities in the over 85 year old age group increased by 28% in 2014 compared to 2005, while the respective fatality rate decreased by 17%.

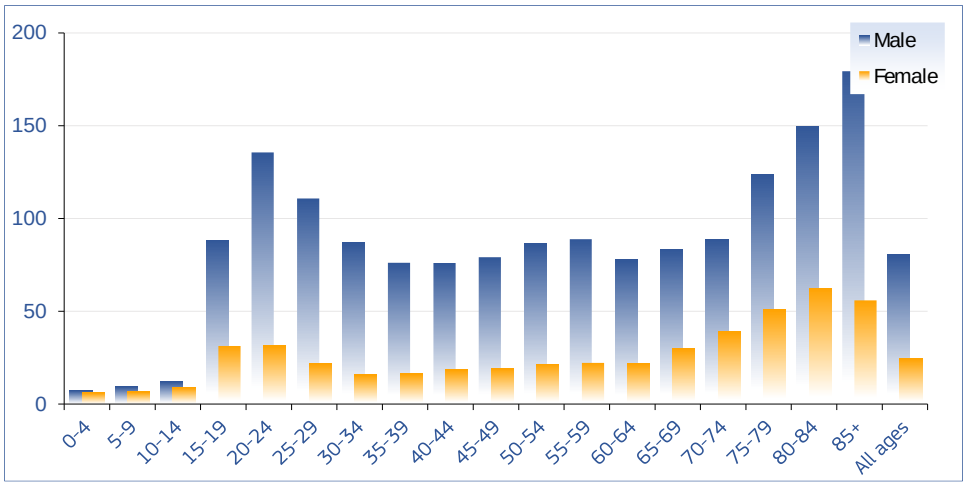


Sources: CARE database (Eurostat for population data), data available in May 2016

Figure 5: *Reduction of road fatalities and road fatality rates by age group, EU, 2005-2014 or latest available year*

The gender of the road users was also considered in the analysis. In 2014, 76% of all fatalities were male and 24% were female. Figure 6 shows that this proportion varies by age and exceeds four fifths between the ages of 20 and 39 years. In addition, rates are high among the young road users (15-29 years old) and then fall with age. They begin to rise again, and rates for eldest

road users (at least 80 years old) are higher than those for the young. In general, the male fatality rate is over three times the female rate, 80 deaths per million population compared with 24.

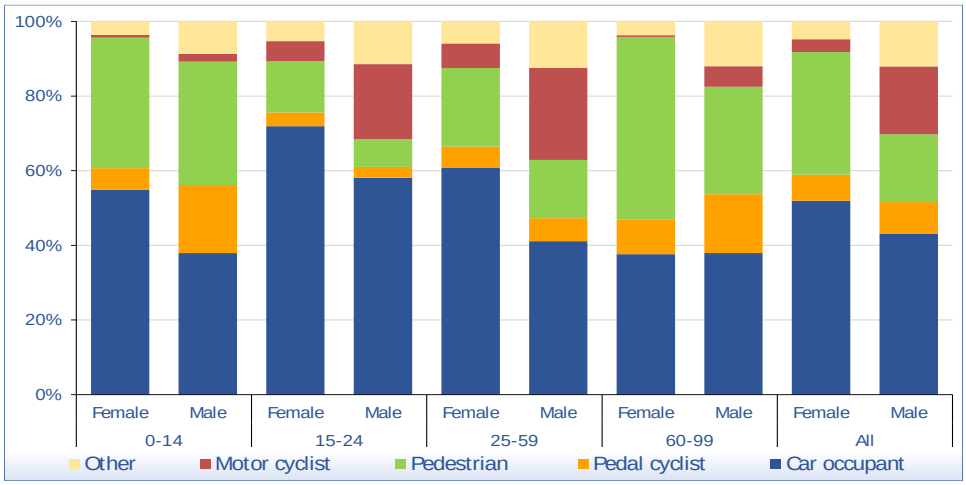


Sources: CARE database (Eurostat for population data), data available in May 2016

Figure 6: *Road fatality rates per million population by age group and gender, EU, 2014 or latest available year*

Age and gender differences of the road fatalities in the EU were also examined concerning the type of road user. Figure 7 compares the male and female fatality distributions by road user type for four age groups. The highest percentages of motorcyclist fatalities in 2014 were recorded for males aged between 15 and 29 years old, whilst the highest rates for pedestrian fatalities were recorded for the elderly women (aged over 60 years old). It is also noted that boys up to 14 years old riding a pedal cycle constitute 18% of males killed in road accidents of this age group.

Concerning all age groups, the male and female distributions of fatalities in the EU by road user type differ considerably. Nearly more than half of female fatalities were car occupants (52%) and almost two thirds were pedestrians (33%), while 43% of male fatalities were car occupants and 18% pedestrians. On the contrary, 18% of male fatalities and only 3% of female fatalities were motorcyclists.

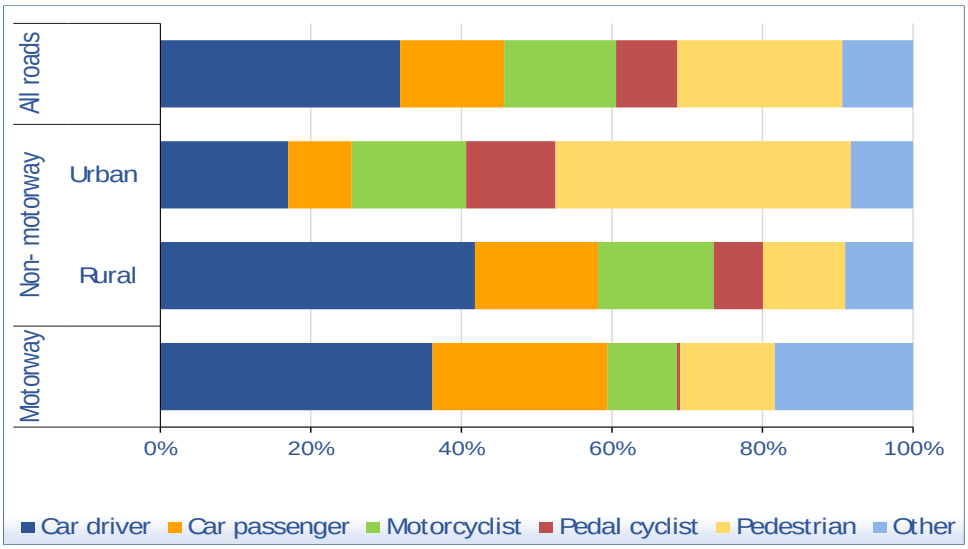


Source: CARE database, data available in May 2016

Figure 7: *Distribution of road fatalities by age, gender and road user type, EU, 2014 or latest available year*

3.2 Mode of transport and road user type

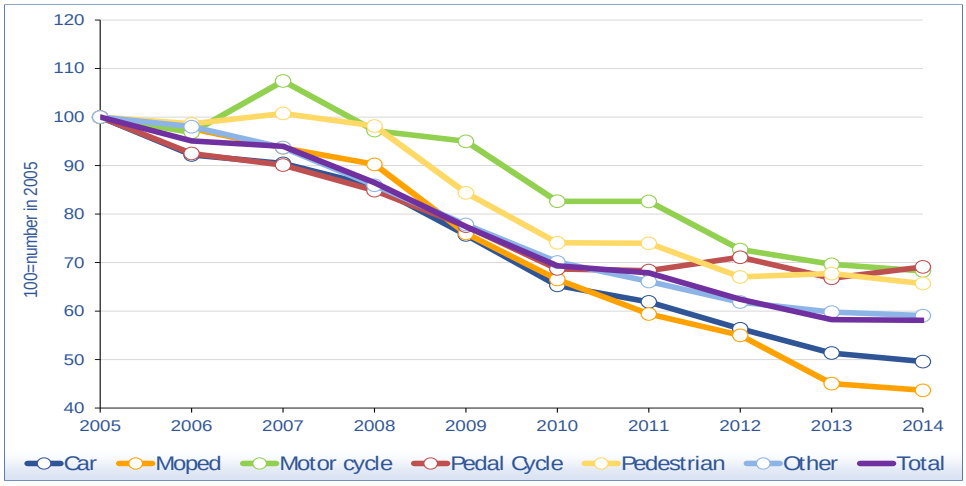
The distribution of fatalities by road user type on motorways, rural and urban roads was also examined, as shown in the Figure 8. This distribution varies with type of road and is influenced by the modes of transport typically used on each type of road. On motorways, where cars are the prevalent mode of transport, almost 60% of all fatalities were car occupants. On urban roads, where there is more non-motorised traffic, almost half of fatalities were pedestrians or cyclists and about one quarter were car occupants.



Source: CARE database, data available in May 2016

Figure 8: *Distribution of road fatalities by road user type and road type, EU, 2014 or latest available year*

Figure 9 shows that the number of fatalities for most groups of road users decreased appreciably between 2005 and 2014. In fact, the total number of fatalities decreased by 42% in the EU countries over this period with moped rider and car passenger fatalities experiencing the highest decreases (56% and 50% respectively). On the other hand, the number of motorcyclist fatalities increased in 2007 and then fell and the number of cyclist fatalities showed annual increases of 4% in 2012 and 2014.

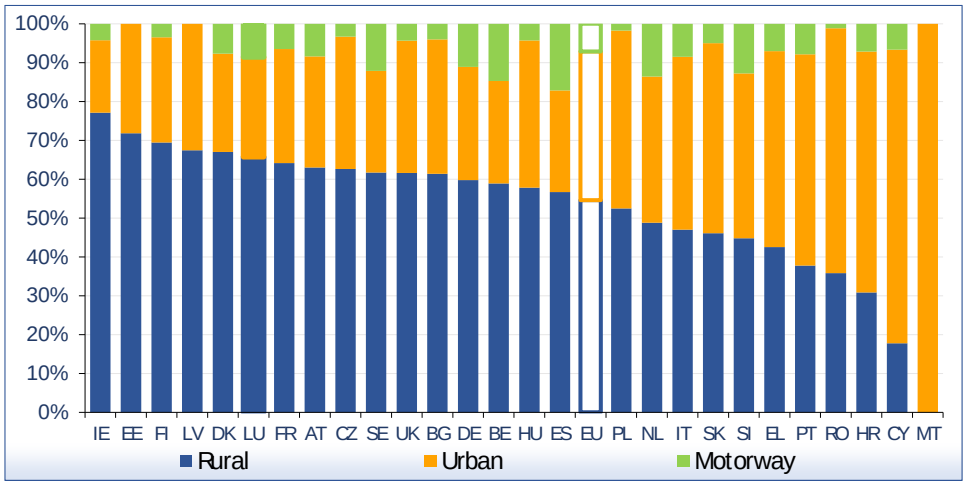


Source: CARE database, data available in May 2016

Figure 9: *Index (2005=100) of road fatalities by mode of transport, EU, 2005-2014*

3.3 Type of road

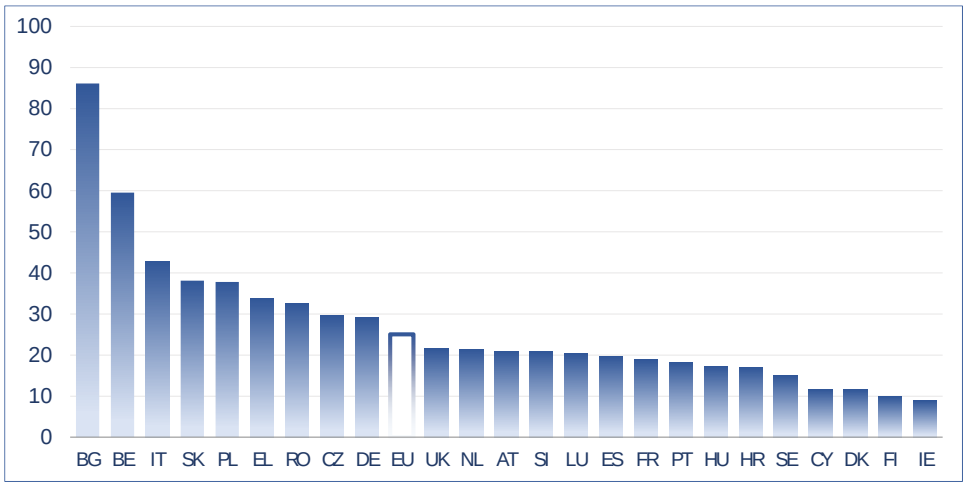
The analysis of the distribution of fatalities by type of road showed that only 7% of road fatalities in 2014 occurred in accidents on motorways and 55% of road users were killed in accidents on non-motorway rural roads. Figure 8 shows the distribution of fatalities by type of road, with countries sorted by the percentage of fatalities occurred on rural roads. Ireland and Estonia had the highest percentages of fatalities on rural roads (over 70%), while Cyprus, Romania and Croatia had the highest percentages of urban road fatalities (76%, 63% and 62% respectively).



Source: CARE database, data available in May 2016

Figure 10: *Distribution of road fatalities by country and type of road, 2014 or latest available year*

To allow for the differences between their motorway networks, Figure 9 compares the rate of fatalities per thousand kilometres of motorways in each country. The fatality rate in 2014 ranged from 8,9 in Ireland to 86,1 in Bulgaria, and the EU average was 25,1.



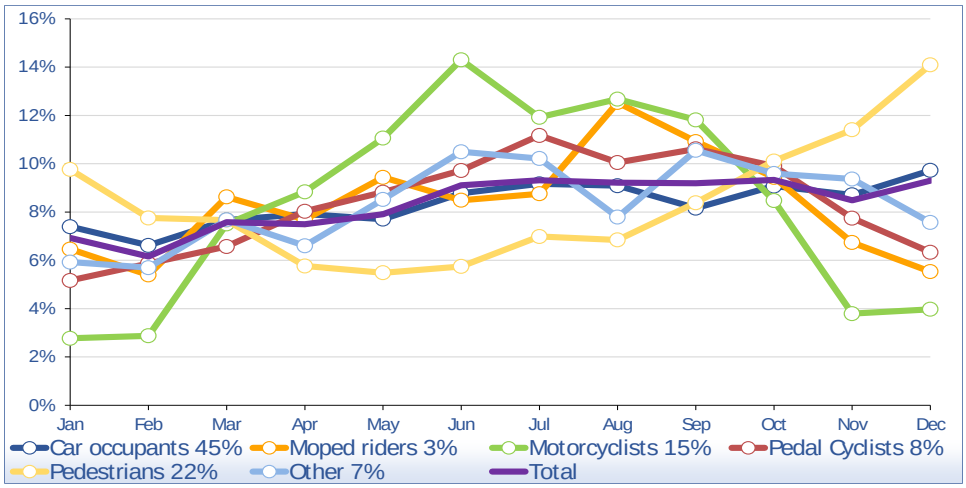
Source: CARE database (Eurostat, EC, IRF for road length data), data available in May 2016

Figure 11: *Motorway fatality rates per 1.000 km of motorway by country, 2014 or latest available year*

3.4 Seasonality

According to the analysis of fatalities by month, the number of fatalities in road accidents ranged between 6% and 9%, with the highest numbers of fatalities being recorded during the second half year. As shown in Figure 12, certain modes have distributions that differ considerably from the overall distribution. More specifically, the peak for pedestrians is in

December, while the peak for motorcyclists and moped riders in the summer is especially pronounced.



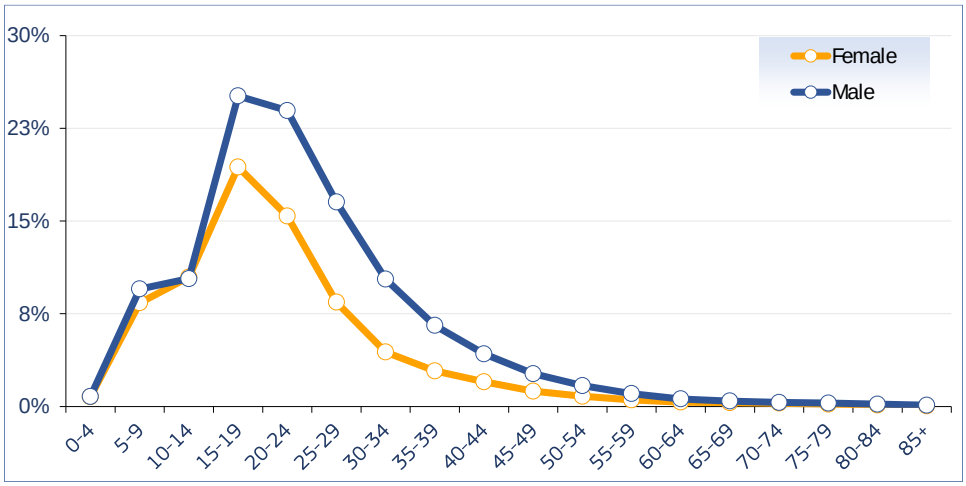
Source: CARE database, data available in May 2016

Figure 12: *Distribution of fatalities by month and road user type, EU, 2014 or latest available year*

3.5 Road accidents' share in overall mortality

Road accidents accounted for 0,53% of all deaths in the EU countries in 2014. Analysis shows that the proportion ranged from 0,91% of all deaths in Luxembourg to 0,30% in Sweden. The same analysis developed by gender showed that road accidents accounted for 0,81% of all male deaths in the EU countries in 2014 and for 0,26% of all female deaths. Among males, the proportion ranged from 1,44% in Luxembourg to 0,44% in Sweden. Among females, the proportion ranged from 0,52% of all deaths in Cyprus to 0,17% in Denmark, Sweden and the United Kingdom.

As shown in the Figure 13, the proportion of fatalities that occur in road accidents varies strongly with age. Road accidents account for about two fifths of fatalities in the 15-19 age group. The percentages for females and males are nearly equal up to the age of 9, but the percentage of fatalities is clearly greater for males than for females thereafter and up to the age of 60.



Source: CARE database (Eurostat for deaths), data available in May 2016

Figure 13: *Percentage of road accident fatalities of all deaths by age group and gender, EU, 2014 or latest available year*

4. Conclusions

The present analysis revealed that road accident fatalities differ considerably among the various groups of road users, as well as in relation to vehicle and road types. In addition, the safety problem varies systematically in the EU by region, reflecting different climates, cultures and behavioural characteristics, modal shares and levels of road infrastructure development.

Analysis of the road accident data derived from the EC CARE database for the decade 2005 – 2014 showed that the number of fatalities was reduced by 42% over this period, however, the decreasing trend stalled at the end of the examined period. CARE accident data were combined with exposure data (population), allowing the more accurate comparison of the calculated rates between the EU countries. According to the results of the analysis, the highest number of fatalities in the EU were recorded between the ages of 20 and 29 years old. However, elderly fatalities (aged over than 64 years old) showed the lowest decrease (21%) during the decade 2005-2014 compared to the 42% reduction of total number of fatalities (ERSO, 2016a). On the contrary, the number of killed people aged between 15-17 years showed an impressive decrease of 62% (ERSO, 2016b). As far as transport mode is concerned, in 2014 about two thirds of female fatalities were pedestrians and an 18% of male fatalities were motorcyclists. It is also worth noting that vulnerable road users and more specifically pedestrian and cyclist fatalities recorded much lower decreases between 2005 and 2014 than the total number of fatalities, i.e. 35% and 30% respectively (ERSO, 2016c; ERSO, 2016d). Additionally, more than half of road users were killed on non-motorway rural roads and most fatalities occurred during the second half year.

The results of the analysis contribute to the better understanding of the road safety problem in the European road network, providing thus useful support to decision makers working for the improvement of road safety level in the EU. Certainly, the effort of data-collection is an on-going challenge and there are additional data that could help shed light to the road safety issue.

Of particular interest are exposure data related to the mobility of road users, as well as road safety performance indicators concerning road users' behaviour, road standards and vehicle conditions. Furthermore, the macroscopic analysis presented in this paper could in the future be combined with more detailed analysis using statistical models, which is necessary for the identification of the combined correlation of the parameters with an impact on road safety and the underlining reasons behind road accident casualties.

Acknowledgements

This paper is based on work carried out by the National Technical University of Athens (NTUA), the Austrian Road Safety Board (KFV) and the European Union Road Federation (ERF) for the European Commission DG Mobility and Transport, updating work carried out within the SafetyNet (The European Road Safety Observatory) and DaCoTA (Data Collection Transfer and Analysis) projects of the 6th and 7th (respectively) Framework Programs for Research, Technological Development and Demonstration of the European Commission.

5. References-Bibliography

Bjorkman K. et al. (2008). *In-depth accident causation database and analysis report, Deliverable 5.8 of the SafetyNet research Project*, Brussels: European Commission.

ETSC (2016). *Ranking EU progress on road safety - 10th Road Safety Performance Index Report*, Brussels: ETSC.

European Commission (2016a). *Traffic Safety Basic Facts on Elderly*. Brussels: European Commission, Directorate General for Transport.

European Commission (2016b). *Traffic Safety Basic Facts on Youngsters*. Brussels: European Commission, Directorate General for Transport.

European Commission (2016c). *Traffic Safety Basic Facts on Pedestrians*. Brussels: European Commission, Directorate General for Transport.

European Commission (2016d). *Traffic Safety Basic Facts on Cyclists*. Brussels: European Commission, Directorate General for Transport.

European Road Safety Observatory (ERSO) http://ec.europa.eu/transport/wcm/road_safety/erso/index-2.html.

Hakkert A.S., & Braimaister L. (2002). *The uses of exposure and risk in road safety studies, SWOV report R-2002-12*, Leidschendam, the Netherlands: SWOV.

Hauer E. (1995). On exposure and accident rate. *Traffic Engineering and Control, 36 (3),* 134-138.

OECD/ITF (2015). *Why does road safety improve when economic times are hard?*. Paris: ITF.

Reed S., & Morris A. (2008). *Glossary of data variables for fatal and accident causation databases, Deliverable 5.5 of the SafetyNet research Project*. Brussels: European Commission.

World Health Organisation (2015). *Global status report on road safety 2015.* Geneva: WHO.

Yannis G., Papadimitriou E., & Folla K. (2014). Effect of GDP changes on road traffic fatalities. *Safety Science*, *63*, 42-49.